

Monogenea (Platyhelminthes) parasites from the gills of *Hoplias* aff. *malabaricus* (Bloch, 1794) (Pisces: Erythrinidae) in the Upper Paraná River Floodplain, States of Paraná and Mato Grosso do Sul, Brazil

Rodrigo J. da Graça^{1,2*}, Bruno H. Ueda^{1,2}, Fabrício H. Oda^{1,3} and Ricardo M. Takemoto^{1,2,3}

1 Universidade Estadual de Maringá (UEM), Laboratório de Ictioparasitologia, Núcleo de Pesquisas em Limnologia, Ictiologia e Aqüicultura (Nupélia) - Bloco G-90. Avenida Colombo, 5790. CEP 87020-900. Maringá, PR, Brazil.

2 Universidade Estadual de Maringá (UEM), Centro de Ciências Biológicas (CCB), Programa de Pós-Graduação em Biologia Comparada (PGB) - Bloco G-80, Sala 201. Av. Colombo, 5790. CEP 87020-900. Maringá, PR, Brazil.

3 Universidade Estadual de Maringá (UEM), Centro de Ciências Biológicas (CCB), Programa de Pós-Graduação em Ecologia de Ambientes Aquáticos Continentais (PEA) - Bloco G-90. Avenida Colombo, 5790. CEP 87020-900. Maringá, PR, Brazil.

* Corresponding author. E-mail: rjgrodriago@gmail.com

ABSTRACT: In this paper, nine species of Monogenea were recorded parasitizing the gills of *Hoplias* aff. *malabaricus* from the Upper Paraná River. The host were collected by gillnets in different regions to the Upper Paraná River Floodplain between March 2010 and March 2011. The parasites were quantified, fixed and preserved according with specialized literature. All hosts analyzed were parasitized by monogeneans. The monogeneans species were recorded *Urocleidoides malabaricus*, *U. cuiabai*, *U. eremitus*, *U. brasiliensis*, *Cosmetocleithrum bulbocirrus*, *Vancleaveus janauacaensis*, *Anacanthorus* sp., Dactylogyridae gen. sp. and Dactylogyridae gen. 1. sp.

INTRODUCTION

Hoplias aff. *malabaricus* (Bloch, 1794), popularly known as “traíra” or “lobó”, is widely distributed in freshwater of South America (Oyakawa 2003). This fish is carnivores, sedentary and occur in several types of fluvial and lacustrine environments (Nakatani *et al.* 2001), especially in shallow water environments and near submerged or marginal vegetation. This fish is easily found in the Upper Paraná River Floodplain and although it is identified as *H. aff. malabaricus* several authors agree this fish is a species complex (Graça and Pavanelli 2007). Pazza and Júlio Jr. (2003), based on cytogenetic data, found three cytotypes in the region, two natives of the Upper Paraná River (*Hoplias* sp. 2 and sp. 3) and one specie introduced *Hoplias* sp. 1, which occur after the flood of Sete Quedas falls by Itaipú Reservoir. Oyakawa (2003) mentioned that the situation of the genera *Hoplias* is quite confusing, because of the large number of species described and the use of features appropriate for their delimitation.

In Brazil, the first record of monogenean species in *Hoplias* aff. *malabaricus* was *Urocleidoides eremitus* Kritsky, Thatcher and Boeger, 1986 from State of Amazonas. In 1995 Boeger and Popazoglo described *Gyrodactylus trairae* parasitizing the body surface of the same host from State of Rio de Janeiro. Rosim *et al.* (2011) reported six species of monogeneans in *H. aff. malabaricus* collected from rivers in different Brazilian regions: Guandu, Jaguari-Mirim and Machado from the Southeast. Araguaia, Cristalino and Cuiabá from Midwest and Paraná between the South and Midwestern regions.

Studies carried out between the years 2000 to 2007 about the diversity of fish parasites from the Upper Paraná River Floodplain registered the occurrence of 20

species of parasites in *H. aff. malabaricus*. However, in this paper, there were no register of monogeneans in this host (Takemoto *et al.* 2009). Recently Graça *et al.* (2013) studied the ecological aspects of monogeneans of *H. aff. malabaricus* from the Upper Paraná River Floodplain and recorded nine species of these parasites in this host. Currently, 10 species of monogeneans are known to *H. aff. malabaricus* (Kritsky *et al.* 1986; Boeger and Popazoglo 1995; Rosim *et al.* 2011; Graça *et al.* 2013).

The present study offers information about gill ectoparasites through a checklist of monogeneans species of *Hoplias* aff. *malabaricus* from Upper Paraná River Floodplain.

MATERIALS AND METHODS

The study area is part of the Upper Paraná River Floodplain in the Paraná and Mato Grosso do Sul States from Brazil (22°43'S, 53°10'W), where is located the base of advanced research at the State University of Maringá (UEM) - Center of Research in Limnology, Ichthyology and Aquaculture (Nupélia) (Figure 1). The sampling points are those used by the project PELD - CNPq (Long Term Ecological Projects) - Site 6. The Site six covers most of the last remaining lowland not dammed the River Paraná in Brazil. In this stretch, the River presents a broad canal anastomosed with reduced slope, sometimes with extensive floodplain and large accumulation of sediment in its bed, resulting in more than 300 bars and small islands, sometimes with large islands and floodplain narrower (Agostinho *et al.* 1995). The floodplain has an extension of approximately 130 km and it is connected numerous secondary channels, backwaters, Baía River and the lower reaches of Ivaí and Ivinheima Rivers.

A total of 54 specimens of *H. aff. malabaricus* were collected quarterly from March 2010 to March 2011, totaling five collection campaigns. The fishes were euthanized with benzocaine 10%. Subsequently, the specimens were identified, the gills removed and fixed in formalin 5%. Collecting, preparation, fixation and mounting of parasites were treated according to Eiras *et al.* (2006). The identification was according to Kritsky *et al.* (1986), Boeger and Vianna (2006) and Rosim *et al.* (2011). Voucher parasite specimens are deposited in the Helminthological Collection of the Instituto Oswaldo Cruz (CHIOC), Rio de Janeiro, Rio de Janeiro, Brazil.

RESULTS

In total, 3640 specimens of monogeneans were registered in this study. All fishes were parasitized by at least one species of parasites. *Urocleidoides cuiabai* Rosim, Mendoza-Franco and Luque, 2011 was the most prevalent species (96.29%), followed by *U. malabaricus* Rosim,

Mendoza-Franco and Luque, 2011 (92.59%). The species with the lowest prevalence were Dactylogyridae gen. 1. sp. and *Cosmetocleithrum bulbocirrus* Kritsky, Thatcher and Boeger, 1986 (1.85%). The list of species of monogenetic and information on levels of parasitism are presented in Table 1.

DISCUSSION

Platyhelminthes Gegenbaur, 1859
Monogenea van Beneden, 1858
Dactylogyridae Bychowsky, 1933
Ancyrocephalinae Bychowsky, 1937

***Urocleidoides* Mizelle and Price, 1964**

The genus *Urocleidoides* was reviewed by Kritsky *et al.* (1986) and from the 30 species listed by Kritsky and Thatcher (1983), only eight were kept in this genus (Kritsky *et al.* 1986). *Urocleidoides* has 22 species in South

FIGURE 1. List of species of monogeneans collected from gills of the *Hoplias* aff. *malabaricus* in Upper Paraná River Floodplain, PR / MS, from March 2010 to March 2011. Access number in Helminthological collection (AN); number of fish infested (NI); number of parasites collected (NP); average intensity (AI); amplitude of parasitism (AP).

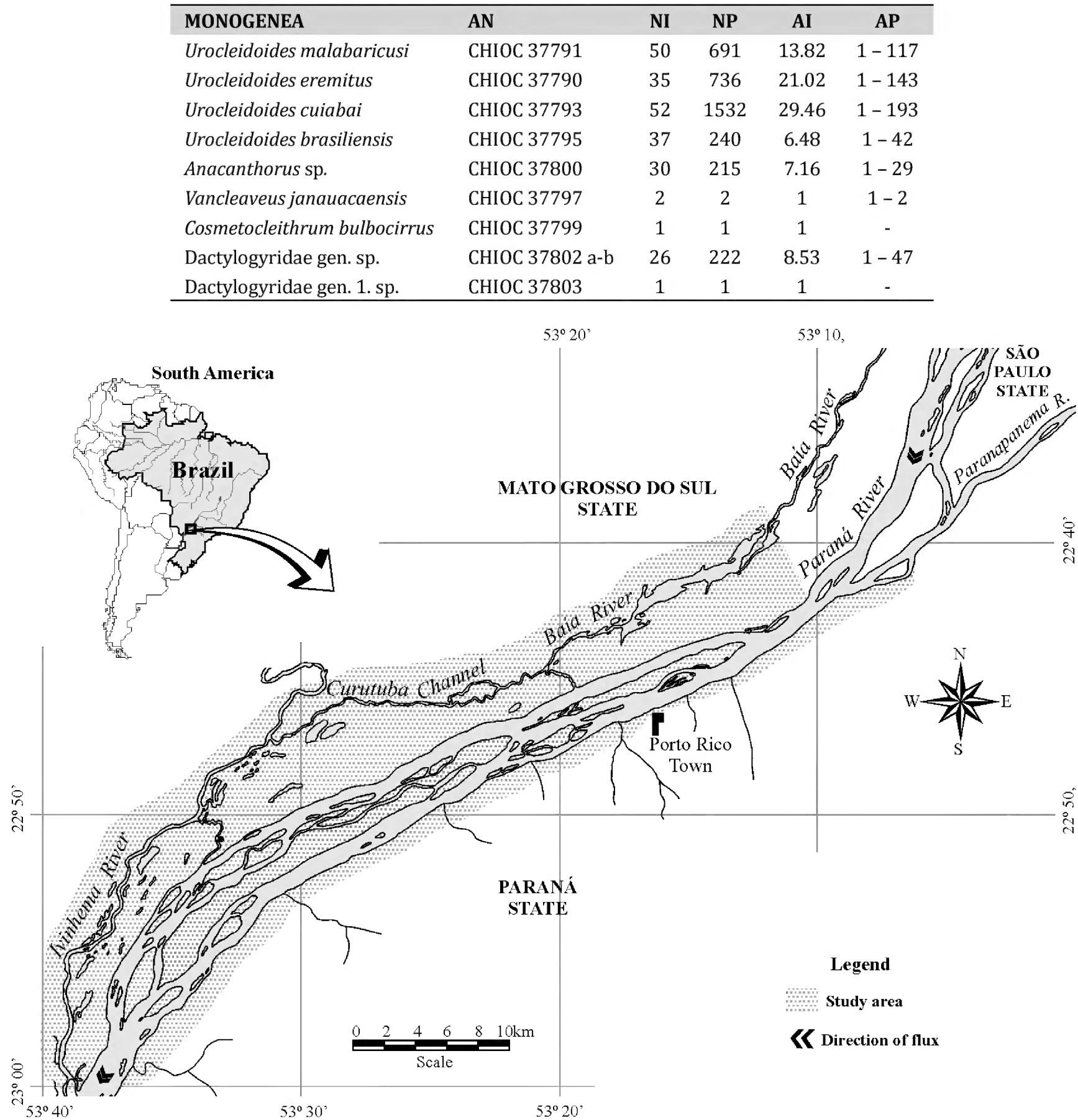


FIGURE 1. Upper Paraná River Floodplain located in the States of Paraná and Mato Grosso do Sul, Brazil.

America (Cohen *et al.* 2013), four of them described recently by Rosim *et al.* (2011) parasitizing *Hoplias* aff. *malabaricus*. According to Eiras *et al.* (2010), the genus *Urocleidoides* does not have host specificity, and this genus can be found in fish of different orders, such as: Siluriformes, Characiformes, Gymnotiformes and Cyprinodontiformes. However, *Urocleidoides cuiabai*, *U. malabaricus*, *U. brasiliensis* and *U. eremitus* so far, has been recorded only in *H. aff. malabaricus*, indicating the specificity for this host.

***Urocleidoides eremitus* Kritsky, Thatcher and Boeger, 1986**

Urocleidoides eremitus was described parasitizing *Hoplias* aff. *malabaricus* collected at Lake Janauacá in Manaus, Amazonas State, Brazil. Recently, Rosim *et al.* (2011) registered *U. eremitus* in *H. aff. malabaricus* collected in four Rivers in Brazil such as, Guandu River in the State of Rio de Janeiro, Jaguari-Mirim River in the State of São Paulo, Machado River in the State of Minas Gerais and Cuiabá River in the State of Mato Grosso.

***Urocleidoides malabaricus* Rosim, Mendoza-Franco and Luque, 2011**

***Urocleidoides cuiabai* Rosim, Mendoza-Franco and Luque, 2011**

***Urocleidoides brasiliensis* Rosim, Mendoza-Franco and Luque, 2011**

Urocleidoides malabaricus, *U. cuiabai* and *U. brasiliensis* were described by Rosim *et al.* (2011) parasitizing the gills of *Hoplias* aff. *malabaricus* collected in different rivers of Brazil. *Urocleidoides malabaricus* was only registered in the hosts collected in the Paraná and Cuiabá Rivers. *Urocleidoides cuiabai* was registered in hosts collected in Paraná, Cuiabá, Guandu, Jaguari-Mirim, Araguaia and Cristalino Rivers (the latter two river are located in the State of Mato Grosso). *Urocleidoides brasiliensis* was registered in *H. aff. malabaricus* collected in Guandu, Cuiabá, Cristalino and Paraná Rivers. These same species, described by Rosim *et al.* (2011), were found in *H. aff. malabaricus* collected in the Upper Paraná River Floodplain by Graça *et al.* (2013).

***Vancleaveus* Kritsky, Thatcher and Boeger, 1986**

***Vancleaveus janauacaensis* Kritsky, Thatcher and Boeger, 1986**

Currently, the genus *Vancleaveus* is composed of five species registered in gills of Siluriformes (Cohen *et al.* 2013). *Vancleaveus janauacaensis* was described parasitizing gills of *Pterodoras granulosus* (Valenciennes, 1821) collected in Lake Janauacá in Manaus in State of Amazonas, Brazil. Recently, *V. janauacaensis* was also registered in *P. granulosus* by Chemes and Takemoto (2011) in the Middle Paraná River in Argentina.

***Cosmetocleithrum* Kritsky, Thatcher and Boeger, 1986**

***Cosmetocleithrum bulbocirrus* Kritsky, Thatcher and Boeger, 1986**

The genus *Cosmetocleithrum* has eight species of fish parasites in Siluriformes (Cohen *et al.* 2013). *Cosmetocleithrum bulbocirrus* was described parasitizing

gills of *Pterodoras granulosus* also collected at Lake Janauacá in Manaus. This parasite also was registered in *Oxydoras niger* (Valenciennes, 1821) by Silva *et al.* (2011) in Coari Lake, tributary of the Solimões River in Amazonas State, Brazil.

DACTYLOGYRIDAE Bychowsky, 1933

Dactylogyridae gen. sp. of Rosim, Mendoza-Franco and Luque, 2011

Rosim *et al.* (2011) registered Dactylogyridae gen. sp. in *Hoplias* aff. *malabaricus* collected in the Jaguari-Mirim, Machado, Cuiabá and Paraná Rivers. Graça *et al.* (2013) reported this parasite specie in *H. aff. malabaricus* collected in the Upper Paraná River Floodplain. These authors, as well as Rosim *et al.* (2011), found none diagnostic features for the inclusion of this species in a known genus.

Dactylogyridae gen. 1. sp.

Dactylogyridae gen. 1 sp. did not have any characteristics that enable the fit in a genera known of monogeneans. This species has a complex copulatory and haptor totally different of the species found by Rosim *et al.* (2011).

Dactylogyridae gen. 1. sp., *Cosmetocleithrum bulbocirrus* and *Vancleaveus janauacaensis* were recorded for the first time in *Hoplias* aff. *malabaricus* by Graça *et al.* (2013). The infestation of parasites of this species in this host can be considered accidental, since the parasitism indexes were low. Another fact that supports this statement is that *C. bulbocirrus* and *V. janauacaensis* has been recorded only in Siluriform fishes.

Dactylogyridae Bychowsky, 1933

Anacanthorinae Price, 1967

***Anacanthorus* Mizelle and Price, 1965**

Anacanthorus is a genus represented by 70 species of monogeneans. It has been described for Characiformes species, according the checklist presented by Cohen *et al.* (2013): Species of *Anacanthorus* were registered by Takemoto *et al.* (2009) parasitizing the gills of *Salminus brasiliensis* (Cuvier, 1816) and *Serrasalmus marginatus* Valenciennes, 1837 from the the Upper Paraná River Floodplain. Cohen *et al.* (2012) described five new species of *Anacanthorus* in *S. brasiliensis* in the Paraná River, *Anacanthorus bicuspidatus*, *A. contortus*, *A. daulometrus*, *A. douradensis* and *A. parakruidenieri*. The first record of a species of *Anacanthorus* in this *Hoplias* aff. *malabaricus* was recently by Graça *et al.* (2013). The species recorded in this study differs from other species of *Anacanthorus* registered in other hosts and it is probably a new species.

ACKNOWLEDGMENTS: We are grateful to Graduate Program in Comparative Biology (PGB), Graduate Program Ecology of Continental Aquatic Environments (PEA), and State University of Maringá (UEM) that provided logistical support and structure during fieldwork. The Nupélia and PELD Project provided support in the collections. RJG and FHO received PhD fellowships from CNPq and CAPES, respectively. RMT is a CNPq partner (process # 305829/2010-6).

LITERATURE CITED

Agostinho, A.A., A.E.A.M. Vazzoler and S.M. Thomaz. 1995. The high Paraná river basin: limnological and ichthyological aspects; p. 59-104 In J.G. Tundisi, C.M. Bicudo and T.T. Matsumura (ed.). *Limnology in Brazil*. Rio de Janeiro: ABC/SBL.

- Boeger, W.A., F. Popazoglo. 1995. Neotropical Monogenoidea. Two new species of *Gyrodactylus* (Gyrodactylidae) from a Cichlid and Erythrinid fish of Southeastern Brazil. *Memórias do Instituto Oswaldo Cruz* 90(6): 689-694.
- Boeger, W.A., R.T. Vianna. 2006. Monogenoidea; p. 42-116 In V.E. Thatcher. *Aquatic Biodiversity in Latin America: Amazon Fish Parasites*. (2nd ed.). Bulgaria: Pensoft. 509 p.
- Chemes, S.B. and R.M. Takemoto. 2011. Diversity of parasites from Middle Paraná system freshwater fishes, Argentina. *International Journal of Biodiversity and Conservation* 3(7): 249-266.
- Cohen, S.C., A. Kohn. and W. A. Boeger. 2012. Neotropical Monogenoidea. Nine new species of Dactylogyridae (Monogenoidea) from the gill of *Salminus brasiliensis* (Characidae, Characiformes) from the Paraná river, State of Paraná, Brazil. *Zootaxa* (3049): 57-68.
- Cohen, S.C., M.C. Justo and A. Kohn. 2013. *South American Monogenoidea Parasites of Fishes, Amphibians and Reptiles*. Rio de Janeiro: Oficina de livros. 663 p.
- Eiras, J.C., R.M. Takemoto and G.C. Pavanelli. 2006. *Métodos de Estudo e Técnicas Laboratoriais em Parasitologia de Peixes* (2nd ed. Revisada e ampliada). Maringá: EDUEM. 199 p.
- Eiras, J.C., R.M. Takemoto and G.C. Pavanelli. 2010. *Diversidade dos parasitos de peixes de água doce do Brasil*. Maringá: Clichetec. 333 p.
- Graça, W.J. and C.S. Pavanelli. 2007. *Peixes da planície de inundação do alto rio Paraná e áreas adjacentes*. Maringá: EDUEM. 241 p.
- Graça, R.J., A.P.L. Costa and R.M. Takemoto. 2013. Ecological aspects of Monogenea gill parasites (Platyhelminthes) from *Hoplias* aff. *malabaricus* (Bloch, 1794) (Pisces, Erythrinidae) in a Neotropical Floodplain. *Neotropical Helminthology* 7(1): 105-116.
- Kritsky, D.C. and V.E. Thatcher. 1983. Neotropical Monogenea. Five new species from the Aruanã, *Osteoglossum bicirrosus* Vandelli, a freshwater teleost from Brazil, with the proposal of *Gonocleithrum* n. gen. (Dactylogyridae: Ancyrocephalinae). *Proceedings of the Helminthological Society of Washington* 96(3): 581-597.
- Kritsky, D.C., V.E. Thatcher and W.A. Boeger. 1986. Neotropical Monogenea. 8. Revision of *Urocleidoides* (Dactylogyridae, Ancyrocephalinae). *Proceedings of the Helminthological Society of Washington* 53(1): 1-37.
- Nakatani, K., A.A. Agostinho, G. Baumgartner, A. Bialecki, P.V. Sanches, M.C. Makrakis and C.S. Pavanelli. 2001. *Ovos e larvas de peixes de água doce: Desenvolvimento e manual de identificação*. Maringá: EDUEM. 378 p.
- Oyakawa, O.T. 2003. Family Erythrinidae; p. 238-240 In R.E. Reis, S.O. Kullander and C.J. Ferraris Jr. (ed.). *Check record the freshwater fishes of South and Central América*. Porto Alegre: Edipucrs.
- Pazza, R. and H.F. Júlio Jr. 2003. Occurrence of three sympatric cytotypes of *Hoplias malabaricus* (Pisces, Erythrinidae) in the upper Paraná river Floodplain (Brazil). *Cytologia* 68(2): 159-163.
- Rosim, D.F., E.F. Mendonza-Franco and J.L. Luque. 2011. New and previously described species of *Urocleidoides* (Monogenoidea: Dactylogyridae) infecting the gills of *Hoplias malabaricus* (Characiformes: Erythrinidae) from Brazil. *The Journal of Parasitology* 97(3): 406-417.
- Silva, A., M. Tavares-Dias, G.T. Jerônimo and M.L. Martins. 2011. Parasite diversity in *Oxydoras niger* (Osteichthyes: Doradidae) from the basin of Solimões river, Amazonas State, Brazil, and the relationship between monogenean and condition factor. *Brazilian Journal of Biology* 71(3): 791-796.
- Takemoto, R.M., G.C. Pavanelli, M.A.P. Lizama, A.C.F. Lacerda, F.H. Yamada, L.H.A. Moreira, T.L. Ceschini and S. Bellay. 2009. Diversity of parasites of fish from the upper Paraná river Floodplain, Brazil. *Brazilian Journal of Biology* 69(2, Suppl.): 691-705.

RECEIVED: July 2013

ACCEPTED: October 2013

PUBLISHED ONLINE: November 2013

EDITORIAL RESPONSIBILITY: Simone Chinicz Cohen